

Listing of claims:

1. (Currently Amended) A process for preparing a polar olefin copolymer comprising:

copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising

(A0) a compound of a transition metal selected from Groups 4, 5, 6, or 11 of the periodic table, which is represented by the following formula (1):



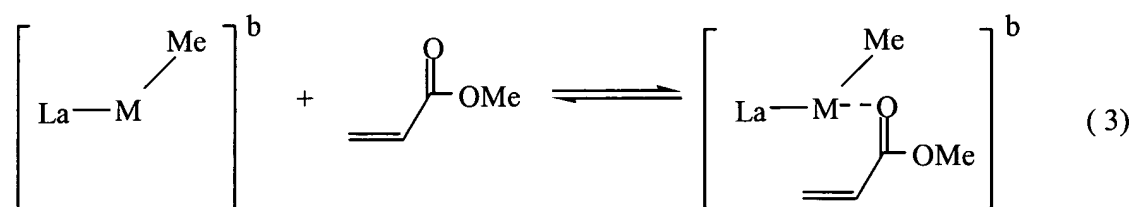
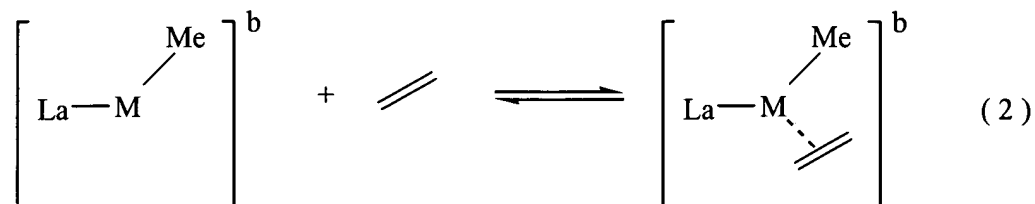
wherein M is a transition metal atom selected from Groups 4, 5, 6, or 11 of the periodic table,

m is an integer of ~~1 to 6~~ 2 to 6,

n is a number satisfying a valence of M,

L is a ligand coordinated to M and each ligand L has a feature that when the value obtained by subtracting the total sum of the whole energy, as determined by a density functional method, of the compounds on the left-hand member from the whole energy, as determined by a density functional method, of the compound on the right-hand member in the following chemical formula (2) and the value obtained by the same subtraction in the following chemical formula (3) are defined as coordination energy E_1 of ethylene and coordination energy E_2 of methyl acrylate, respectively, the difference ΔE ($\Delta E = E_1 - E_2$) between the

coordination energy E_1 of ethylene and the coordination energy E_2 of methyl acrylate is 50 kJ/mol or less,



wherein M is the same transition metal atom selected from Groups 4, 5, 6, or 11 of the periodic table as M in the formula (1), a is an integer of 1 to 3, b is an electric charge of the compound in the ~~blankets~~ brackets [] and is 0 or 1, and Me is a methyl group, and

X is a hydrogen atom, a halogen atom, an oxygen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residual group, silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural atoms or groups indicated by X may be the same

or different, and plural groups indicated by X may be bonded to each other to form a ring.

2. (Previously Presented) A process for preparing a polar olefin copolymer comprising copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising

(A0) a compound of a transition metal selected from Groups 4, 5, 6, or 11 of the periodic table, which is represented by the formula (1) as defined in claim 1, and

(B) at least one compound selected from the group consisting of

(B-1) an organometallic compound,

(B-2) an organoaluminum oxy-compound, and

(B-3) a compound which reacts with a transition metal compound (A0) to form an ion pair.

3. (Canceled)

4. (Original) A process for producing a polar olefin copolymer comprising copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising:

(A1) a reaction product of

(C) a compound of a transition metal selected from Groups 4, 5, 6 and 11 of the periodic table which is represented by the following formula (c):

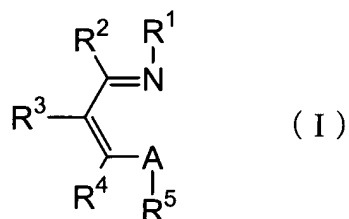


wherein M' is a transition metal atom selected from Groups 4, 5, 6 and 11 of the periodic table,

k is a number satisfying a valence of M', and

X is a hydrogen atom, a halogen atom, an oxygen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, and when k is 2 or greater, plural atoms or groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to each other to form a ring, and

(A-i) a compound represented by the following formula (I):



wherein A is an oxygen atom, a sulfur atom or a selenium atom, or a nitrogen atom having a substituent R⁶, and

R^1 to R^6 may be the same or different, they are each a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of them may be bonded to each other to form a ring; and

(B) at least one compound selected from the group consisting of:

(B-1) an organometallic compound,

(B-2) an organoaluminum oxy-compound, and

(B-3) a compound which reacts with the reaction product (A1) to form an ion pair.

5. (Withdrawn) A process for producing a polar olefin copolymer comprising copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising:

(A2) a reaction product of

(C) a compound of a transition metal selected from Groups 4, 5, 6 and 11 of the periodic table which is represented by the following formula (c):

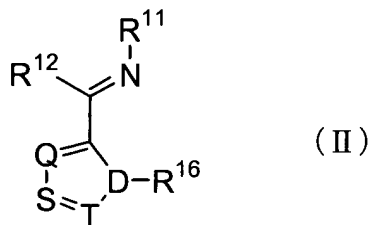


wherein M' is a transition metal atom selected from Groups 4, 5, 6 and 11 of the periodic table,

k is a number satisfying a valence of M', and

X is a hydrogen atom, a halogen atom, an oxygen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, and when k is 2 or greater, plural atoms or groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to each other to form a ring, and

(A-ii) a compound represented by the following formula (II):



wherein D is a nitrogen atom or a phosphorus atom,

Q is a nitrogen atom or a phosphorus atom, or a carbon atom substituted with a substituent R¹³,

S is a nitrogen atom or a phosphorus atom, or a carbon atom substituted with a substituent R^{14} ,

T is a nitrogen atom or a phosphorus atom, or a carbon atom substituted with a substituent R^{15} ,

R^{11} to R^{16} may be the same or different, they are each a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of them may be bonded to each other to form a ring; and

(B) at least one compound selected from the group consisting of:

(B-1) an organometallic compound,

(B-2) an organoaluminum oxy-compound, and

(B-3) a compound which reacts with the reaction product (A2) to form an ion pair.

6. (Original) A process for producing a polar olefin copolymer comprising copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising:

(A3) a reaction product of

(C') a compound of a transition metal selected from Groups 3 to 11 of the periodic table, which is represented by the following formula (c'):

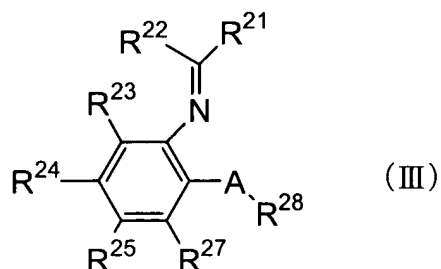


wherein M is a transition metal atom selected from Groups 3 to 11 of the periodic table,

k is a number satisfying a valence of M, and

X is a hydrogen atom, a halogen atom, an oxygen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, and when k is 2 or greater, plural atoms or groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to each other to form a ring, and

(A-iii) a compound represented by the following formula (III):



wherein A is an oxygen atom, a sulfur atom or a selenium atom, or a nitrogen atom having a substituent R^{26} , and

R^{21} to R^{28} may be the same or different, they are each a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of them may be bonded to each other to form a ring.

7. (Original) A process for producing a polar olefin copolymer comprising copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising:

(A3) a reaction product of

(C') a compound of a transition metal selected from Groups 3 to 11 of the periodic table, which is represented by the following formula (c'):



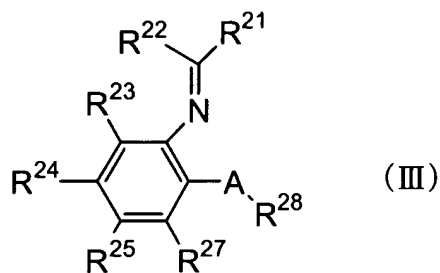
wherein M is a transition metal atom selected from Groups 3 to 11 of the periodic table,

k is a number satisfying a valence of M, and

X is a hydrogen atom, a halogen atom, an oxygen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-

containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, and when k is 2 or greater, plural atoms or groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to each other to form a ring, and

(A-iii) a compound represented by the following formula (III):



wherein A is an oxygen atom, a sulfur atom or a selenium atom, or a nitrogen atom having a substituent R^{26} , and

R^{21} to R^{28} may be the same or different, they are each a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a heterocyclic compound residual group, a silicon-containing group, a

germanium-containing group or a tin-containing group, two or more of them may be bonded to each other to form a ring;
and

(B) at least one compound selected from the group consisting of:

(B-1) an organometallic compound,

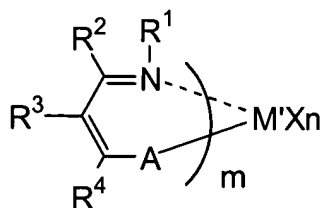
(B-2) an organoaluminum oxy-compound, and

(B-3) a compound which reacts with the transition metal compound (A3) to form an ion pair.

8. (Previously Presented) The process for producing a polar olefin copolymer as claimed in claim 6 or 7, wherein the compound of a transition metal represented by the formula (c') is a compound of a transition metal selected from Groups 4, 5, 6 or 11 of the periodic table.

9. (Withdrawn) A process for producing a polar olefin copolymer comprising copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising:

(A4) a compound of a transition metal selected from Groups 4, 5, 6 and 11 of the periodic table, which is represented by the following formula (IV):



... (IV)

wherein M' is a transition metal atom selected from Groups 4, 5, 6 and 11 of the periodic table,

m is an integer of 1 to 6,

A is an oxygen atom, a sulfur atom or a selenium atom, or a nitrogen atom having a substituent R⁶,

R¹ to R⁴ and R⁶ may be the same or different, they are each a hydrogen atom, a halogen atom, a hydrocarbon group, a heterocyclic compound residual group, an oxygen-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a sulfur-containing group, a phosphorus-containing group, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of them may be bonded to each other to form a ring, and when m is 2 or greater, one group of R¹ to R⁴ and R⁶ contained in one ligand and one group of R¹ to R⁴ and R⁶ contained in other ligands may be bonded, and R¹s, R²s, R³s, R⁴s or R⁶s may be the same or different,

n is a number satisfying a valence of M', and

X is a hydrogen atom, a halogen atom, an oxygen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural atoms or groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to each other to form a ring;

and

(B) at least one compound selected from the group consisting of:

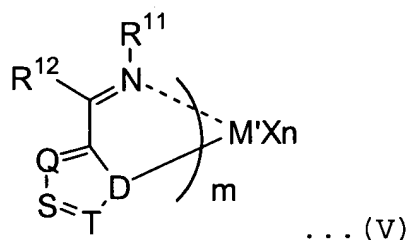
(B-1) an organometallic compound,

(B-2) an organoaluminum oxy-compound, and

(B-3) a compound which reacts with the transition metal compound (A4) to form an ion pair.

10. (Withdrawn) A process for producing a polar olefin copolymer comprising copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising:

(A5) a compound of a transition metal selected from Groups 4, 5, 6 and 11 of the periodic table which is represented by the following formula (V)



wherein M' is a transition metal atom selected from Groups 4, 5, 6 and 11 of the periodic table,

m is an integer of 1 to 6,

D is a nitrogen atom or a phosphorus atom,

Q is a nitrogen atom or a phosphorus atom, or a carbon atom substituted with a substituent R^{13} ,

S is a nitrogen atom or a phosphorus atom, or a carbon atom substituted with a substituent R^{14} ,

T is a nitrogen atom or a phosphorus atom, or a carbon atom substituted with a substituent R^{15} ,

R^{11} to R^{15} may be the same or different, they are each a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of them may be bonded to each other to form a ring, and when m is 2 or greater, one group of R^{11} to R^{15} contained in one ligand and one group of R^{11} to R^{15} contained in other ligands may

be bonded, and $R^{11}s$, $R^{12}s$, $R^{13}s$, $R^{14}s$ or $R^{15}s$ may be the same or different,

n is a number satisfying a valence of M' , and

X is a hydrogen atom, a halogen atom, an oxygen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural atoms or groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to each other to form a ring;

and

(B) at least one compound selected from the group consisting of:

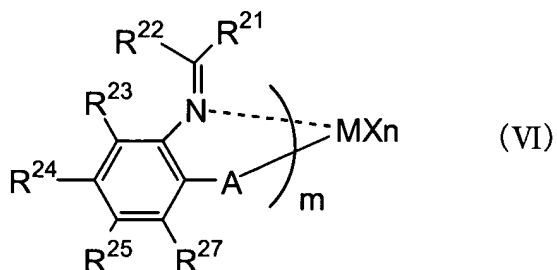
(B-1) an organometallic compound,

(B-2) an organoaluminum oxy-compound, and

(B-3) a compound which reacts with the transition metal compound (A5) to form an ion pair.

11. (Withdrawn) A process for producing a polar olefin copolymer comprising copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising:

(A6) a compound of a transition metal selected from Groups 3 to 11 of the periodic table, which is represented by the following formula (VI):



wherein M is a transition metal atom selected from Groups 3 to 11 of the periodic table,

m is an integer of 1 to 6,

A is an oxygen atom, a sulfur atom or a selenium atom, or a nitrogen atom having a substituent R^{26} ,

R^{21} to R^{27} may be the same or different, they are each a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of them may be bonded to each other to form a ring, and when m is 2 or greater, one group of R^{21} to R^{27} contained in one ligand and one group of R^{21} to R^{27} contained in other ligands may

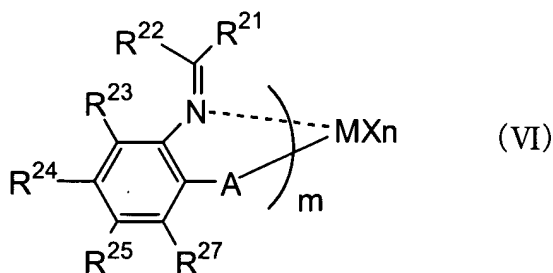
be bonded, and $R^{21}s$, $R^{22}s$, $R^{23}s$, $R^{24}s$, $R^{25}s$, $R^{26}s$ or $R^{27}s$ may be the same or different,

n is a number satisfying a valence of M , and

X is a hydrogen atom, a halogen atom, an oxygen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural atoms or groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to each other to form a ring.

12. (Withdrawn) A process for producing a polar olefin copolymer comprising copolymerizing a non-polar olefin and a polar olefin in the presence of a catalyst comprising:

(A6) a compound of a transition metal selected from Groups 3 to 11 of the periodic table, which is represented by the following formula (VI):



wherein M is a transition metal atom selected from Groups 3 to 11 of the periodic table,

m is an integer of 1 to 6,

A is an oxygen atom, a sulfur atom or a selenium atom, or a nitrogen atom having a substituent R^{26} ,

R^{21} to R^{27} may be the same or different, they are each a hydrogen atom, a halogen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, two or more of them may be bonded to each other to form a ring, and when m is 2 or greater, one group of R^{21} to R^{27} contained in one ligand and one group of R^{21} to R^{27} contained in other ligands may be bonded, and $R^{21}s$, $R^{22}s$, $R^{23}s$, $R^{24}s$, $R^{25}s$, $R^{26}s$ or $R^{27}s$ may be the same or different,

n is a number satisfying a valence of M, and

X is a hydrogen atom, a halogen atom, an oxygen atom, a hydrocarbon group, an oxygen-containing group, a sulfur-containing group, a nitrogen-containing group, a boron-containing group, an aluminum-containing group, a phosphorus-containing group, a halogen-containing group, a heterocyclic compound residual group, a silicon-containing group, a germanium-containing group or a tin-containing group, and when n is 2 or greater, plural atoms or groups indicated by X may be the same or different, and plural groups indicated by X may be bonded to each other to form a ring;

and

(B) at least one compound selected from the group consisting of:

(B-1) an organometallic compound,

(B-2) an organoaluminum oxy-compound, and

(B-3) a compound which reacts with the transition metal compound (A6) to form an ion pair.

13. (Withdrawn) The process for producing a polar olefin copolymer as claimed in claim 11 or 12, wherein the compound of a transition metal represented by the formula (VI) is a compound of a transition metal selected from Groups 4, 5, 6 and 11 of the periodic table.

14. (Withdrawn) A polar olefin copolymer obtained by the process according to claim 1.